Data Collection from a Sensor Network using a Quadcopter

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Abstract

The purpose of this project is to implement an automated data collection drone that fly's to wireless sensor nodes and collects measurement data. This is intended for sensor networks that are placed too far apart to communicate wirelessly or need to operate on very low power in remote locations. An off the shelf quad copter was outfitted with an Arduino and a ZigBee for collecting data from nodes and storing the data on a micro SD card through openlog. The drone uses a GPS module with provided coordinates for navigation. Each node is constructed using an Arduino, a ZigBee and a temperature sensor.

Introduction

Wireless sensor networks have a budding future in environmental and agricultural monitoring[2]. However, maintaining a sensor network over a large area can stretch the limits of a sensor networks wireless capabilities and battery lifetime[1]. Furthermore retrieving data from these sensors is incredibly difficult if one cannot communicate directly with the network as a whole or if they cannot communicate with each other. A quadcopter has the capability to traverse over rugged terrain easily, making it an ideal alternative if direct communication with nodes is not an option. The biggest obstacle to this implementation is that quadcopters have a limited battery life of 7-15 minutes, which provides a design challenge for the power draw of the data collection components.

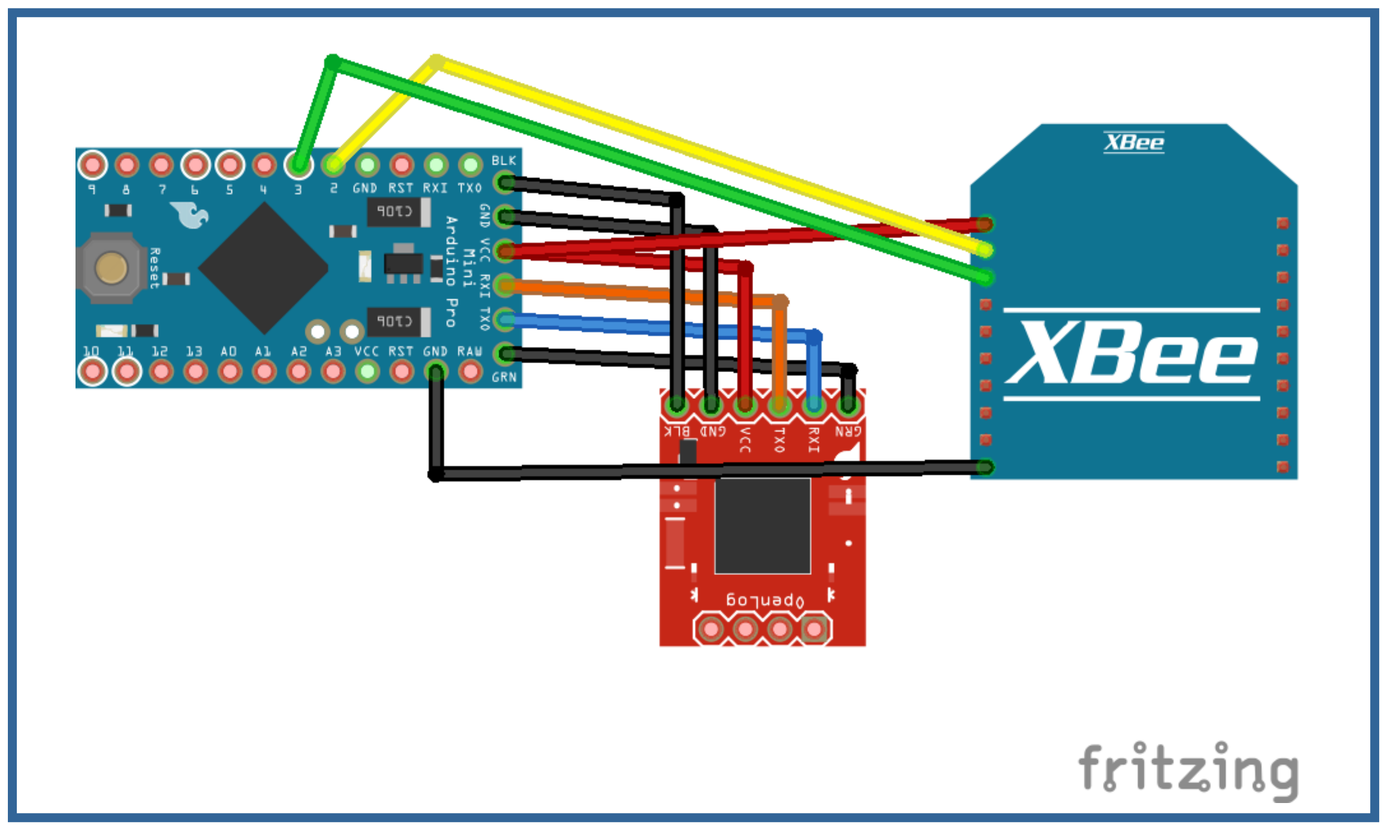

Figure (1) Drone Data Collection Schematic

Drone Structure

The quadcopter is an off-the-shelf model (UDI U818A) with control signals mimicked and sent through a NRF24L01+ transceiver connected to an Arduino connected to a PC which acts as a sort of base station. The data collection system is separate from the quad copters pre-built flight controller. As shown in figure 1, it consists of an Arduino pro mini, a ZigBee transceiver for communicating with sensor nodes and an openlog for storing collected data.

[1]Valente, João, David Sanz, Antonio Barrientos, Jaime del Cerro, Ángela Ribeiro, and Claudio Rossi. "An Air-Ground Wireless Sensor Network for Crop Monitoring." Sensors 11, no. 6 (2011): 6088–6108.

[2]C. Zhan, Y. Zeng, and R. Zhang. "Energy-Efficient Data Collection in UAV Enabled Wireless Sensor Network." IEEE Wireless Communications Letters PP, no. 99 (2017): 1–1. https://doi.org/10.1109/LWC.2017.2776922.